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Filling gap and new state record of *Lithodytes lineatus* (Schneider, 1799) (Anura, Leptodactylidae) from the eastern Brazilian Amazon

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Abstract

Lithodytes lineatus (Schneider, 1799) is a medium-sized frog distributed throughout South America and found in the Amazonia and Cerrado domains of Brazil. Here we document two new records of this species in forested areas in the state of Amapá, northern Brazil, and provide an updated distribution map. The record from Laranjal do Jari extends the distribution of *L. lineatus* approximately 78 km northeast from the nearest locality, Floresta Estadual do Paru, in the municipality of Monte Alegre, state of Pará, Brazil, and helps to fill information gaps.

Keywords

Biogeography, geographic distribution, gold-striped frog, Guiana shield, range extension

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Introduction

The Neotropical genus *Lithodytes* Fitzinger, 1843 is represented by a single species, *Lithodytes lineatus* (Schneider, 1799), which was recently removed from the synonymy of *Leptodactylus* Fitzinger, 1826 by Pyron and Wiens (2011) and proposed as the sister taxon of the genus *Adenomera* Steindachner, 1867. *Lithodytes lineatus* is a leaf-litter frog found in transitional areas between the Amazon and Cerrado domains (Thaler et al. 2020). This species is characterized by a black dorsum with two yellow or yellowish cream dorsolateral stripes, small white spots on both sides of the head, ventral surface grey to light grey with or without cream spots, large red spots on the groin and dorsal surface of the thigh, and snout–vent length ranging from 33–45 mm in males and 44–56 in females (Rodríguez and Duellman 1994; Lima et al. 2006; Cole et al. 2013).

The distribution of *Lithodytes lineatus* comprises several localities in the South America, including the Amazonia in Bolivia (De La Riva et al. 2000), Colombia (Lamar and Wild 1995; Lynch 2005), Ecuador (Rodríguez and Duellman 1994), Guyana (Lescure and Marty 2000), Peru (Duellman 2005; Schlüter et al. 2009), Venezuela (Señaris et al. 2002), Suriname (Ouboter and Jairam 2012), and in the Brazilian states of Acre (Bernarde et al. 2011; Bernarde et al. 2013), Amazonas (Lima et al. 2006; Prudente et al. 2013; Menin et al. 2017), Pará (Caldwell and Araújo 2005; Ávila-Pires et al. 2010), Rondônia (Bernarde 2007; Bernarde and Kokubum 2009), Mato Grosso

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(Sá et al. 2005), Tocantins (Cintra et al. 2014; Thaler et al. 2020), and Maranhão (Freitas et al. 2014).

Concerning the distribution of *Lithodytes lineatus* in the Brazilian Amazonia, the possible occurrence in the state of Amapá has been speculated by La Marca et al. (2010), Cintra et al. (2014), and Thaler et al. (2020). However, there was no collected data confirming its distribution in the state. Therefore, this study provides a new state record for *L. lineatus* in two localities of the state of Amapá, eastern Brazilian Amazonia.

Methods

The new record of *Lithodytes lineatus* was based on two specimens collected during field work conducted in two localities in the state of Amapá, northern Brazil. Specimens were collected using visual surveys (Heyer et al. 1994). Vouchers specimens and tissue samples were housed in the Herpetological Collection of the Federal University of Amapá (CECC), Macapá, Brazil. In order to produce an updated distributional map, geographic coordinates were obtained from herpetological surveys, literature and speciesLink database (http://www.splink.org.br; Table 1). The map was developed using Google Earth and QGIS software (QGIS Development Team 2017).

Results

New record. BRAZIL • 1 adult ♂, snout–vent length (SVL) 45.6 mm; state of Amapá, municipality of Serra do Navio, Cancão Municipal Natural Park; 00°54′50″N, 052°00′25″W; 159 m a.s.l.; 9 March 2018; Marcos R. Dias Souza leg. (Fig. 1A, B); CECC 1776. • 1 juvenile ♂, SVL 38.1 mm; state of Amapá, municipality of Laranjal do Jari, Rio Iratapuru Sustainable Development Reserve; 00°25′54″S, 052°38′54″W; 69 m a.s.l.; 10 April 2019; Vinícius A. M. B. de Figueiredo leg. (Fig. 1C, D); CECC 1971.

Table 1. Geographic coordinates (latitude and longitude in degrees, minutes and seconds) from literature and speciesLink records for the occurrence of *Lithodytes lineatus*.

Country	Locality	Latitude	Longitude	Source
Brazil	Amapá, Laranjal do Jari, Rio Iratapuru Sustainable Development Reserve	00°25′54″S	052°38′55″W	This study
Brazil	Amapá, Serra do Navio, Cancão Municipal Natural Park	00°54′50″N	052°00′25″W	This study
Brazil	Acre, Cruzeiro do Sul	07°38′23″S	072°47′43″W	Bernarde et al. 2013
Brazil	Acre, Igarapé Esperança	07°57′18″S	072°04′37″W	Bernarde et al. 2011
Brazil	Amazonas, Boca do Acre	09°01′34″S	067°14′09″W	França and Venâncio 2010
Brazil	Amazonas, Boca do Acre	09°01′46″S	067°10′51″W	França and Venâncio 2010
Brazil	Amazonas, Boca do Acre	09°01′32″S	067°14′24″W	França and Venâncio 2010
Brazil	Amazonas, Boca do Acre	09°01′45″S	067°05′26″W	França and Venâncio 2010
Brazil	Amazonas, Boca do Acre	08°46′48″S	067°21′13″W	França and Venâncio 2010
Brazil	Amazonas, Boca do Acre	08°50′02″S	067°18′16″W	França and Venâncio 2010
Brazil	Amazonas, Coari, Urucu Petrol Basin	04°45′00″S	065°00′00″W	Prudente et al. 2013
Brazil	Amazonas, Manaus, Adolpho Ducke Reserve Forest	02°57′50″S	059°55′30″W	Lima et al. 2006
Brazil	Amazonas, Manaus, Piagaçu-Purus Sustainable Development Reserve	04°03′00″S	061°36′00″W	Waldez et al. 2013
Brazil	Amazonas, Manaus, Rio Preto da Eva	02°20′29″S	059°12′50″W	Ilha and Dixo 2010
Brazil	Amazonas, Manaus, Universidade Federal do Amazonas	03°05′55″S	059°58′06″W	Rojas-Ahumada and Menin 2010
Brazil	Maranhão, Bom Jardim, Biological Reserve Gurupi	04°00′18″S	046°46′40″W	Freitas et al. 2014
Brazil	Mato Grosso, Araputanga	15°02′57″S	058°45′05″W	speciesLink 2020
Brazil	Mato Grosso, Aripuanã, Dardanelos	10°08′58″S	059°27′02″W	São-Pedro et al. 2009
Brazil	Mato Grosso, Cláudia, Continental Farm	11°26′46″S	055°02′57″W	speciesLink 2020
Brazil	Mato Grosso, Cotriguaçu, São Nicolau Farm	09°51′16″S	058°14′57″W	Noronha et al. 2015
Brazil	Mato Grosso, Guarantã do Norte	09°40′50″S	054°57′37″W	speciesLink 2020
Brazil	Mato Grosso, Igarapés do Juruena State Park	08°54′46″S	059°06′14″W	speciesLink 2020
Brazil	Mato Grosso, Igarapés do Juruena State Park	08°53′32″S	059°06′51″W	speciesLink 2020
Brazil	Mato Grosso, Nova Ubiratã, Small Hydropower Plant	12°59′35″S	054°45′59″W	speciesLink 2020
Brazil	Mato Grosso, Paranaíta	09°34′17″S	056°46′45″W	speciesLink 2020
Brazil	Mato Grosso, Paranaíta, Foz do Apiacás	09°28′23″S	057°03′18″W	speciesLink 2020
Brazil	Mato Grosso, Rio Roosevelt Ecological Station	08°59′40″S	060°45′55″W	speciesLink 2020
Brazil	Mato Grosso, Vale de São Domingos	15°06′00″S	058°34′48″W	speciesLink 2020
Brazil	Pará, Alenquer, Grão-Pará South Ecological Station	00°09′55″S	055°11′11″W	Ávila-Pires et al. 2010
Brazil	Pará, Almeirim, Maicuru Biological Reserve	00°49′43″N	053°55′52″W	Ávila-Pires et al. 2010
Brazil	Pará, Faro, Faro State Forest	01°42′50″S	057°12′47″W	Ávila-Pires et al. 2010
Brazil	Pará, Jacareacanga	06°13′19″S	057°45′10″W	speciesLink 2020
Brazil	Pará, Marabá, Tapirapé Biological Reserve	05°30′13″S	050°16′40″W	Bernardo et al. 2012
Brazil	Pará, Monte Alegre, Paru State Forest	00°56′38″S	053°14′10″W	Ávila-Pires et al. 2010
Brazil	Pará, Óbidos, Grão-Pará Centre Ecological Station	00°37′49″N	055°43′42″W	Ávila-Pires et al. 2010
Brazil	Pará, Oriximiná, Grão-Pará North Ecological Station	01°17′07″N	058°41′45″W	Ávila-Pires et al. 2010
Brazil	Pará, Oriximiná, Trombetas State Forest	00°57′45″S	055°31′20″W	Ávila-Pires et al. 2010
Brazil	Pará, Vitória do Xingu	02°52′48″S	052°00′36″W	speciesLink 2020
Brazil	Rondônia, Espigão d'Oeste, Jaburi Farm	11°34′58″S	060°40′58″W	Bernarde 2007
Brazil	Rondônia, Espigão d'Oeste, Jaburi Farm	09°24′41″S	064°26′38″W	Barros et al. 2016
Brazil	Rondônia, Madeira, Rio Madeira	09°08′47″S	064°30′34″W	Barros et al. 2016
Brazil	Rondônia, Nova Brasília	011°09′0″S	061°34′12″W	speciesLink 2020

Country	Locality	Latitude	Longitude	Source
Brazil	Rondônia, Porto Velho, Rio Jamari	08°45′42″S	063°54′14″W	speciesLink 2020
Brazil	Tocantins, Araguaína	07°06′16″S	048°11′23″W	Thaler et al. 2020
Brazil	Tocantins, Caseara	09°24′25″S	049°58′21″W	Thaler et al. 2020
Brazil	Tocantins, Filadélfia	07°43′12″S	047°49′54″W	Cintra et al. 2014
Brazil	Tocantins, Filadélfia, Rio Tocantins	07°43′04″S	047°49′54″W	Cintra et al. 2014
Brazil	Tocantins, Palmeirante	07°52′26″S	047°57′05″W	Pavan 2007
Bolivia	Beni	14°54′08″S	064°43′43″W	De La Riva et al. 2000
Bolivia	Cochabamba	17°33′42″S	066°11′01″W	De La Riva et al. 2000
Bolivia	La Paz	16°41′34″S	068°04′05″W	De La Riva et al. 2000
Bolivia	Pando	11°01′44″S	068°52′54″W	De La Riva et al. 2000
Bolivia	Santa Cruz	17°49′11″S	063°17′48″W	De La Riva et al. 2000
Colombia	Amazonas, La Pedrera, Río Apaporis	01°22′58″S	069°24′57″W	speciesLink 2020
Colombia	Amazonas, Mirití-Paraná, Puerto Guayabo	01°00′00″S	070°36′00″W	speciesLink 2020
Colombia	Caquetá, Solano, Río Cuemaní	00°23′51″S	072°52′16″W	speciesLink 2020
Colombia	Meta, Barranca de Upía, Río Guavio	04°42′57″N	073°01′48″W	speciesLink 2020
Colombia	Meta, El Calvario, La Forzosa Sabana	04°23′45″N	073°06′10″W	speciesLink 2020
Colombia	Meta, La Uribe, Parque Nacional Natural Tinigua	02°45′00″N	074°09′00″W	speciesLink 2020
Colombia	Meta, Puerto Lleras	03°18′09″N	073°22′01″W	speciesLink 2020
Colombia	Meta, Villavicencio	04°11′20″N	073°36′33″W	speciesLink 2020
Colombia	Meta, Villavicencio, Hacienda "LaGuardia"	04°11′30″N	073°35′52″W	speciesLink 2020
Colombia	Meta, Villavicencio, Río Guatiquía	04°09′10″N	073°38′06″W	speciesLink 2020
Colombia	Vaupés, Taraira, Estación Caparú Lago Taraira	01°05′34″S	069°30′00″W	speciesLink 2020
Ecuador	Napo	00°03′00″N	076°58′60″W	Hödl 1990
Ecuador	Napo, Estacíon Biológica Jatun Sacha	01°03′36″S	077°36′57″W	Vigle 2008
Ecuador	Orellana, Estación de Biodiversidad Tiputini	00°37′04″S	076°10′18″W	Cisneros-Heredia 2003
Ecuador	Pastaza, Chuintza	02°00′00″S	076°40′50″W	Almendáriz 1987
Ecuador	Pastaza, Montalvo	02°03′59″S	076°57′59″W	Almendáriz 1987
Ecuador	Pastaza, Montalvo, Rio Bobonaza	02°03′60″S	076°57′59″W	Hoogmoed 1986
Ecuador	Pastaza, Pozo Balsaura	01°57′59″S	076°25′59″W	Almendáriz 1987
Ecuador	Pastaza, Pozo Misión	02°12′59″S	076°30′59″W	Almendáriz 1987
Ecuador	Pastaza, Pozo Shionayuca	02°06′00″S	076°37′59″W	Almendáriz 1987
Ecuador	Pastaza, Shiona	02°00′59″S	078°27′59″W	Almendáriz 1987
Ecuador	Sucumbíos, Nueva Loja, Río Aguarico	00°06′00″N	076°51′36″W	speciesLink 2020
Ecuador	Sucumbíos, Puerto Libre, Río Aguarico	00°04′32″N	076°45′09″W	speciesLink 2020
Ecuador	Sucumbíos, Santa Cecilia, Río Aguarico	00°03′00″N	076°57′36″W	speciesLink 2020
French Guiana	Bassin de l' Approuague	04°01′48″N	052°31′57″W	Lescure and Marty 2000
French Guiana	Bassin de l' Oyapock	03°19′17″N	052°11′41″W	Lescure and Marty 2000
French Guiana	Cayenne, Presqu'ile de Cayenne	04°53′20″N	052°22′24″W	Lescure and Marty 2000
French Guiana	Comté, Bassin de la Comté	04°33′40″N	052°30′19″W	Lescure and Marty 2000
French Guiana	Kaw, Montagne et Marais Kaw	04°30′51″N	052°03′59″W	Lescure and Marty 2000
French Guiana	Maripasoula, Borne 4	02°23′44″N	053°43′58″W	Dewynter and Chaline 2016
French Guiana	Maripasoula, Haute Wanapi	02°41′03″N	053°48′50″W	Fouquet et al. 2019
French Guiana	Sinnamary, Bassin de la Sinammary	05°21′55″N	052°57′59″W	Lescure and Marty 2000
Guyana	Baramita, Barima-Waini	07°22′14″N	060°29′28″W	Reynolds and MacCulloch 2012
Guyana	Berbice River Camp	05°05′06″N	058°14′13″W	Cole et al. 2013
Guyana	Dubulay Ranch	05°40′54″N	057°51′31″W	Cole et al. 2013
Guyana	Kanashen	01°46′59″N	058°33′00″W	Nelson and Miller 1971
Guyana	Kartabo	06°21′00″N	058°40′59″W	Cole et al. 2013
Guyana	Konawaruk Camp	05°13′07″N	059°02′42″W	Cole et al. 2013
Guyana	Mabura Hill	05°09′11″N	058°41′51″W	Ernst et al. 2005
Guyana	Mabura Hill, Mabura Hill Forest Reserve	05°12′59″N	058°48′00″W	Ernst et al. 2005
Peru	Manu, Mabura Hill Forest Reserve	12°33′59″S	070°06′00″W	May et al. 2009
Peru	Cuenca del Río Yubineto	00°52′33″S	074°42′57″W	speciesLink 2020
Peru	Huánuco Panguana	09°34′59″S	074°48′00″W	Hödl 1990
Peru	Oxapampa, Iscozacin	10°12′04″S	075°09′22″W	Lehr 2001
Peru	Oxapampa, Puerto Amistad	09°55′40″S	074°55′25″W	Lehr 2001
Peru	Panguana	09°34′59″S	074°55′59″W	Schlüter and Rëgos 1996
Suriname	Brokopondo	05°04′13″N	055°23′43″W	Ouboter and Jairam 2012
Suriname	Oost	05°39′49″N	055°07′00″W	Ouboter and Jairam 2012
Suriname	Kabalebo	04°30′42″N	056°49′50″W	Ouboter and Jairam 2012
Suriname	Kabalebo	04°24′33″N	056°54′55″W	Ouboter and Jairam 2012
Suriname	Kwakoegron	05°54′38″N	055°07′45″W	Ouboter and Jairam 2012
Suriname	Patamacca	05°17′18″N	054°16′50″W	Ouboter and Jairam 2012
Suriname	Sipaliwini, Apalagadi Mountain	02°10′41″N	056°05′06″W	Fouquet et al. 2015
Suriname	Sipaliwini, Sipaliwini community	02°01′36″N	056°07′32″W	Fouquet et al. 2015
Venezuela	Bolívar, Gran Sabana, Rio Ourowapa	05°54′38″N	062°44′22″W	Senãris et al. 2002
Venezuela	Táchira, Las Cuevas, Valle del Rio Doradas	07°54′56″N	072°08′20″W	Barrio 1999
Venezuela	Trujillo, La Gira, Betijoque	09°19′48″N	070°43′53″W	Barros and Barrio 2001
Venezuela	Zulia, Sierra de Perijá	10°01′42″N	072°48′20″W	Barros and Barrio 2001

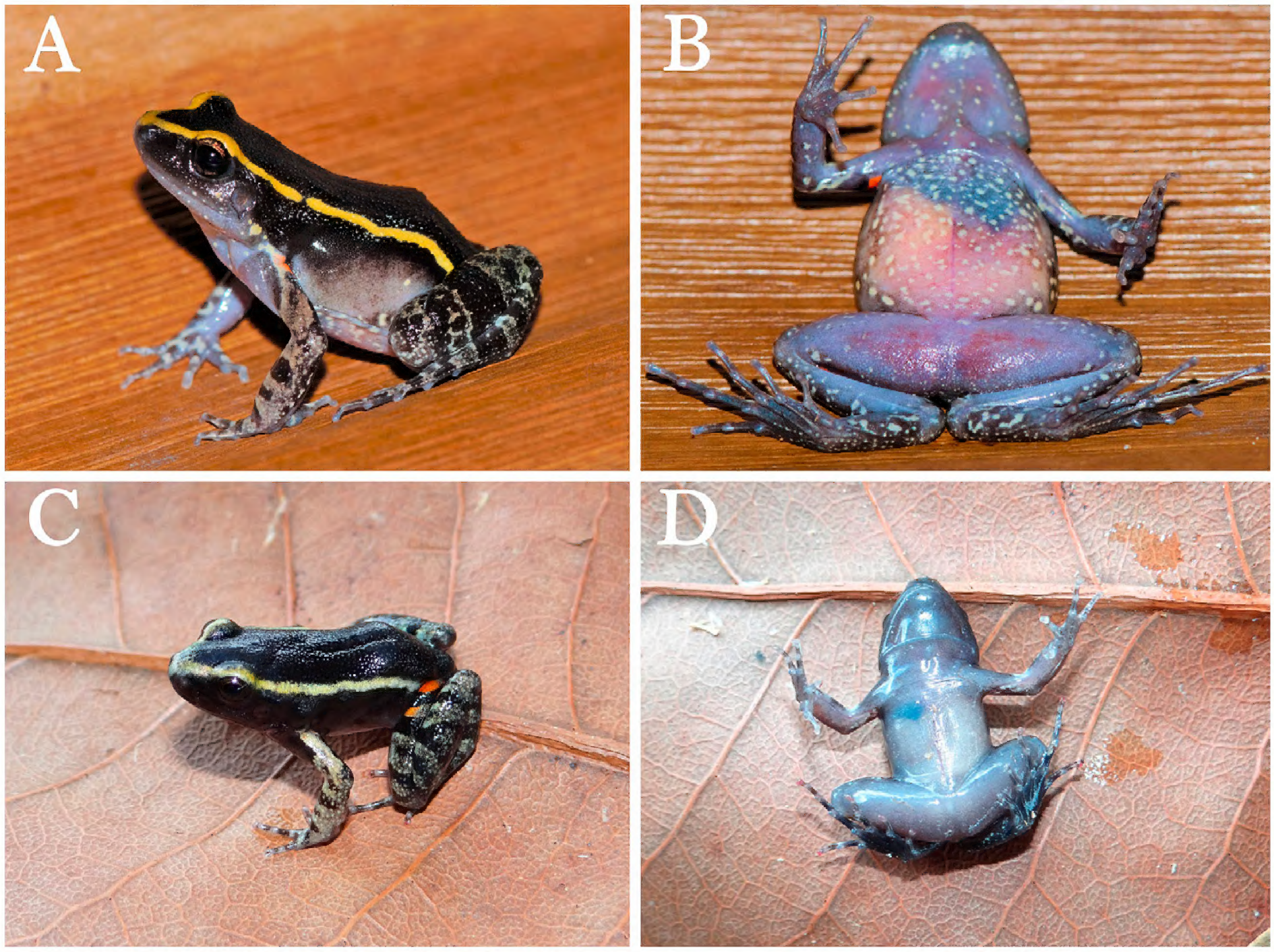

Figure 1. Specimens of *Lithodytes lineatus* collected in the state of Amapá, Brazil. **A**–**B.** Adult male (CECC 1776) from the Cancão Municipal Natural Park, municipality of Serra do Navio. **C**–**D.** Juvenile (CECC 1971) from the Rio Iratapuru Sustainable Development Reserve, municipality of Laranjal do Jari.

Identification. Both specimens were identified as *L. lineatus* by its coloration, which is characterized by a black dorsum with yellowish or cream dorsolateral stripes, hind limbs with transverse brown bars on a light or dark brown background, grey or light grey ventral surface, and red spots on the groin, armpits, and dorsal surface of thighs (Lima et al. 2006).

Discussion

The record of *Lithodytes lineatus* in the Rio Iratapuru Sustainable Development Reserve (Amapá, Brazil) extends its distribution approximately 78 km northeast from the nearest locality, Floresta Estadual do Paru, in the municipality of Monte Alegre, state of Pará, Brazil (Fig. 2). This species is distributed throughout Amazonia and adjacent areas from South America, and in Brazil, it reaches transitional areas and forest habitats in the Brazilian Cerrado (La Marca et al. 2010; Cintra et al. 2014; Thaler et al. 2020). These records highlight the lack in our knowledge on the geographical distribution of Neotropical anurans and are essential to understand the local and regional diversity. In some Brazilian localities, information on species distribution is scarce (Azevedo-Ramos and Galatti 2002), highlighting the importance of biological inventories, especially in the eastern Brazilian Amazonia.

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Authors' Contributions

MRDS, VAMBF, RTP, and CECC made the record and wrote the paper. CECC and VAMBF took photographs of the specimens. All authors have read and approved the submitted manuscript.

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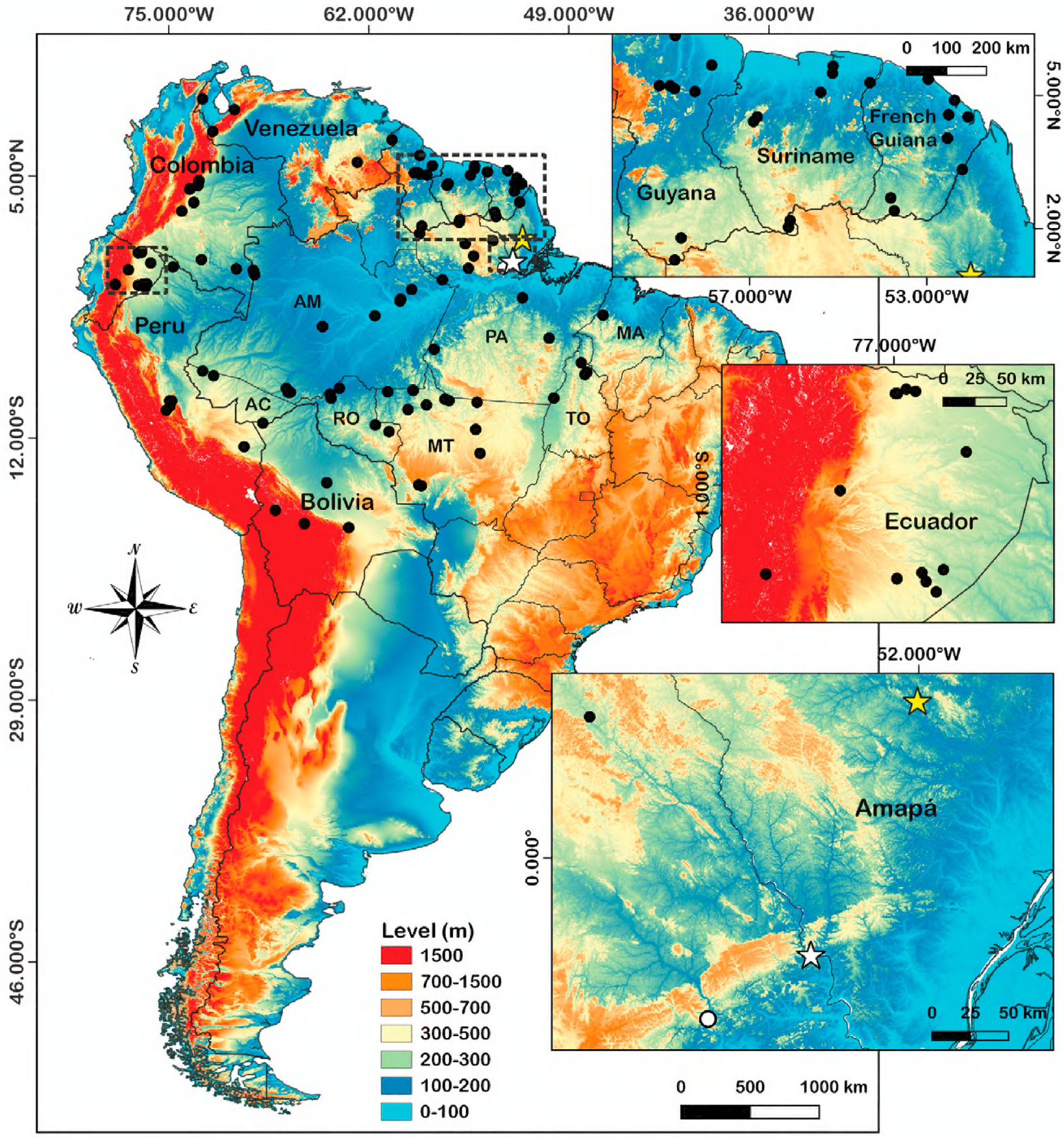

Figure 2. Updated geographical distribution of *Lithodytes lineatus*. Circles: previous records in other localities according literature. White circle: nearest locality, Floresta Estadual do Paru, municipality of Monte Alegre, state of Pará, Brazil. Yellow and white stars: new records in the municipality of Serra do Navio and Laranjal do Jari, Amapá, Northern Brazil, respectively. AC: Acre; AM: Amazonas; MA: Maranhão; MT: Mato Grosso; PA: Pará; RO: Rondônia; TO: Tocantins.

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